Observations on the 2009 southbound migration of three bee-eater species at Radar Hill, Thailand

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Introduction

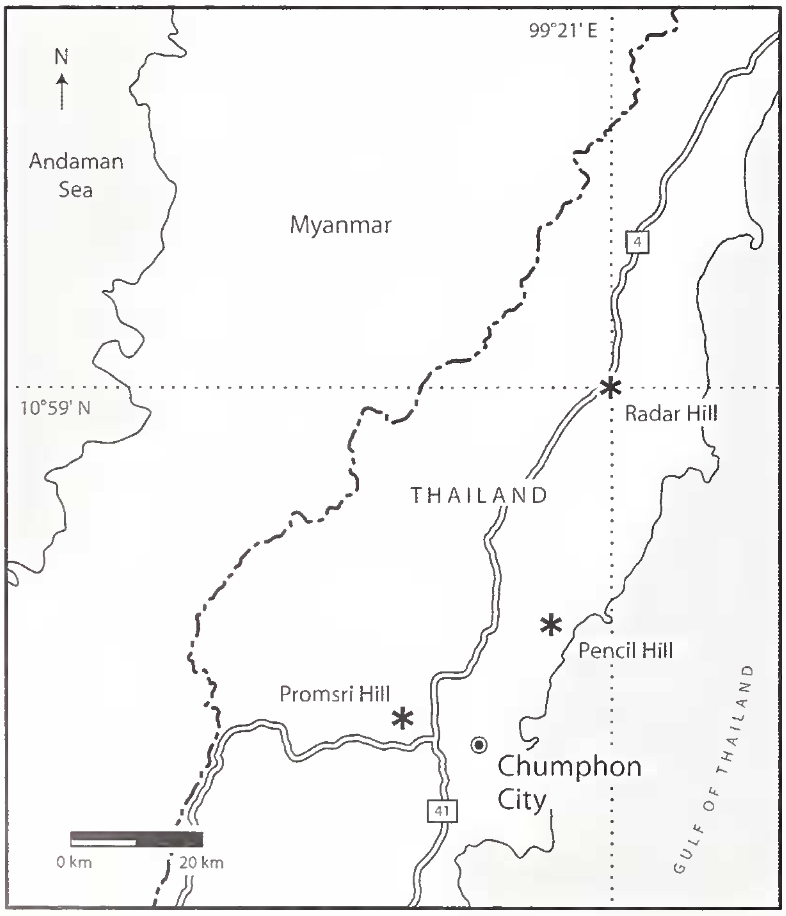
In Thailand and Malaysia, primarily from mid-August until mid-November, two bee-eater species have been regularly observed in southbound migration: Blue-tailed *Merops philippinus* and Blue-throated *M. viridis*. These continental migrants are returning to overwinter in Malaysia, Singapore, Sumatra and elsewhere (Wells 1999, Round 2008). However, still unclear are the migration timing, number of additional *Merops* species, populations and total number of individuals involved, as well as their ultimate destination(s).

In autumn 2009, we participated in a survey of migrating raptors at Radar Hill, an inland raptor watch site in peninsular Thailand, c.61 km north of our spring raptor and *Merops* watch site, Promsri Hill (Figure 1). We were particularly interested in studying southbound bee-eater migration here through the Isthmus of Kra, the narrowest portion of the Thai–Malay Peninsula. To date, the only comprehensive studies of migrating bee-eaters in Asia have been during northbound (spring) migration (DeCandido *et al.* 2004a, 2004b, 2010).

Materials and methods

From 19 September until 8 November 2009 we made daily counts of bee-eaters, migrating raptors and other birds from the top of Radar Hill (10°59'29"N 99°21'59"E; elevation 195 m), c.5 km north of the small town of Chairat in peninsular Thailand, and c.400 km south-south-west of Bangkok. The start and end dates of the study were selected to coincide with the annual raptor migration count that is held here. We typically made observations from c.06h45 until 18h00 daily. However, if we suspected that birds might be migrating after 18h00, we remained until we were sure all southbound movement had ended for the evening. On two days, 3 October and 11 October, no observations were made because rain prevailed all day. During periods of steady rain we found that bee-eaters did not migrate, and it was difficult, if not impossible, to locate the few migrants that might be on the wing.

Figure 1. The location of Radar Hill on the Isthmus of Kra in peninsular Thailand, in relation to other migration count sites, the Gulf of Thailand and Myanmar.



Radar Hill is almost 2 km due east of the Khao Pho Service Area on the southbound side of the main road, also called Phetkasem Road or Highway 4. The flat summit is easily reached by car or by foot on a well-paved road. The observation hill is part of the Isthmus of Kra, the narrowest portion of Thailand. To the north, Radar Hill overlooks a large unnamed valley where oilpalm and rubber plantations have replaced the lowland hill evergreen forest. Some 15 km to the east the Gulf of Thailand can be seen on most days, while to the west the hills of Myanmar (Burma) are visible. Radar Hill is leased and maintained by the Telephone Organization of Thailand. Two towers (rising c.25 m above the summit) have been built near the top. Vegetation higher than 1 m is regularly removed from most of the hill, providing excellent 360° views of the surrounding landscape.

All three species of bee-eaters observed, Blue-tailed, Blue-throated and Chestnut-headed *M. leschenaulti*, were counted in migration using 8× and 10× binoculars. We recorded data in hour-long blocks. We also counted individuals of 23 raptor species in migration, primarily Black Baza *Aviceda leuphotes*, Chinese Sparrowhawk *Accipiter soloensis* and Oriental Honey-buzzard *Pernis ptilorhynchus* (for more information about raptor migration at Radar Hill, see: www.thairaptorgroup.com).

We measured wind speed and direction, temperature, humidity and barometric pressure with a hand-held weather station (Kestrel 4000, Nielsen-Kellerman corporation, U.S.A.). Wind direction was determined with a compass. Early in the season (until 9 October) winds were light from the south-west (<10 km/h) in the morning, typically becoming more westerly and increasing slightly in intensity in the afternoon. From 25 September until 7 October the weather was often unsettled with frequent light mist to drizzle. From 10 October until 28 October it was calm: light morning southwesterly winds usually became easterly (south-east to east) in the afternoon. From late October until 8 November winds were strong (13–24 km/h) from the north-east on most days. Throughout the observation period, barometric pressure rose in the morning until c.11h00, and then decreased for the remainder of the day as coastal air replaced continental air that was rising rapidly on strong thermals.

To locate migrants, observers scanned primarily to the north, east and west for oncoming birds. Bee-eater flocks usually migrated just over the tree-tops in the valley below us. We usually detected migrants when they passed just below the observation site along the ridge heading to the south-west or south-east. We did not attempt to age or sex migrants because nuances of plumage differences seemed impossible to detect given the distance we saw most of the birds, their relatively small size and the brief time-frame we observed them in. Even 50 m distance makes bee-eaters difficult to see in certain light conditions.

To determine the seasonal peak migration period for *M. philippinus*, we used the highest consecutive seven-day count. Since we saw many fewer *M. leschenaulti* and *M. viridis*, we did not compute a peak passage time for these two species. We used a Chi-square test (with one degree of freedom) to test whether significantly more bee-eaters were counted when winds had an easterly component vs a westerly component. We hypothesised that because bee-eaters are known to drift with prevailing winds, at Radar Hill easterly winds would be likely to be associated with greater numbers of migrants passing this inland count site, while westerly winds would probably push migrants towards the coast and out of our field of view.

Results

We counted a total of 7,240 bee-eaters, averaging 13.0 birds/hour. These included 6,909 *M. philippinus* (95.4% of all *Merops*); 14 *M. viridis* (0.2%); and 21 *M. leschenaulti* (0.3%). We also tallied 296 unidentified *Merops* individuals (4.1% of the total counted bee-eater flight).

Most bee-eaters were observed migrating north to south within 50 m of the watch site. The first day of the survey, 19 September 2009, revealed flocks of migrating *M. philippinus*, but the first *M. viridis* was not observed until 4 October, while the first flock of this species was seen on 6 October. The first *M. leschenaulti* were seen on 29 October. Small flocks of *M. philippinus* were seen on migration at Radar Hill until the penultimate day of this survey, 7 November. Almost all bee-eaters were travelling in flocks, although a handful of lone migrant *M. philippinus* (eight) was observed, and on one occasion (12 October) a single *M. viridis* was seen in migration. Fewer than five times were lone individuals of *M. viridis* seen migrating within flocks of *M. philippinus*, and never *vice versa*. There were no resident *Merops* in the area.

Figure 2. Total number of bee-eaters of three species counted per day during the 2009 southbound migration at Radar Hill, Thailand.

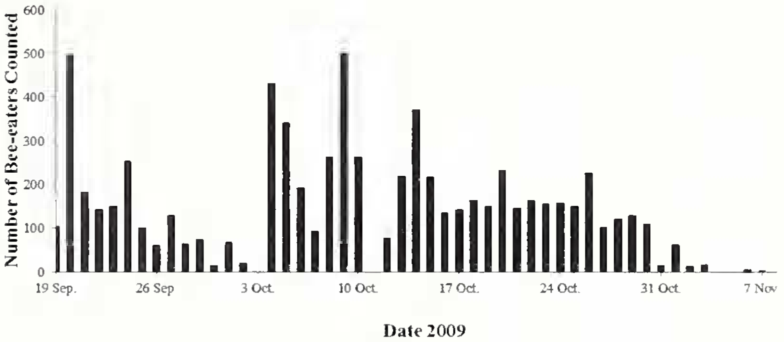


Figure 3. Average number of *Merops* individuals counted per hour in migration at Radar Hill, Thailand, from 19 September until 8 November 2009.

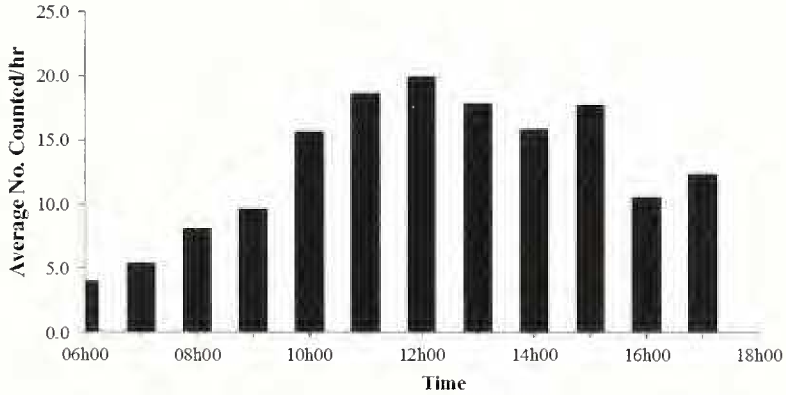
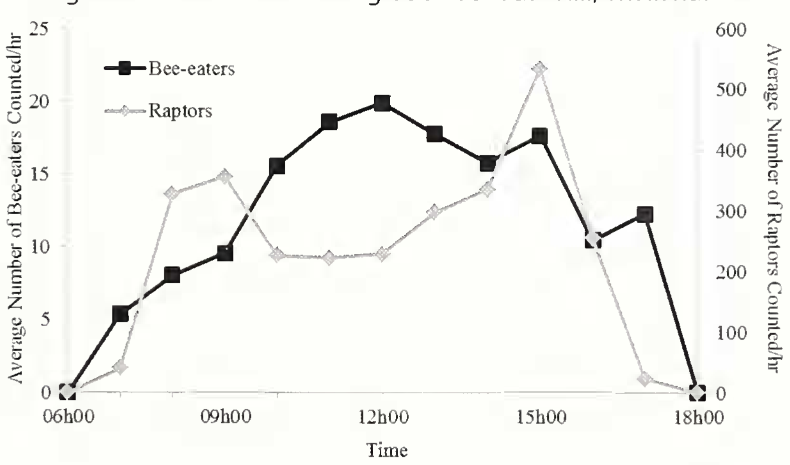


Figure 4. Average number of bee-eaters vs raptors counted per hour during the 2009 southbound migration at Radar Hill, Thailand.



The highest single-day count of migrating *Merops* in this study was 501 on 9 October (Figure 2). The peak seven-day time-frame of their migration occurred during 4–10 October, averaging 298 migrants/day. During this time, for *M. philippinus*, the mean flock size (of 310 flocks) was 6.5 birds (standard deviation [s.d.] = 5.0), and the rate averaged 25.9 migrants/hour. The largest flock of migrant *M. philippinus* was 65 that passed the watch site between 17h00 and 18h00 on 10 October. We counted many fewer *M. viridis* (14 total; three flocks; 6–10 October) and *M. leschenaulti* (21 total; three flocks; 30 October–2 November). Figure 2 suggests that, overall, *Merops* migration in this area of eastern peninsular was completed by around 10 November. Bee-eater migration was not significantly greater when winds had an onshore easterly (north-east, east or south-east) component than when winds were from other directions.

Most (59.8%) bee-eaters were seen from 11h00 to 16h00, with 12h00 to 13h00 being the peak hour for migrants (13.2% of all bee-eaters counted) (Figure 3). The highest hourly total occurred from 11h00 to 12h00 on 20 September when 182 bee-eaters passed the watch site.

In the morning, migration activity for both bee-eaters and raptors began at about 07h00 (Figure 4). Bee-eater migration increased gradually until 12h00. By comparison, raptor activity peaked during 08h00–10h00, primarily Chinese Sparrowhawk and Oriental Honey-buzzard until mid-October, and then mostly Black Baza from late October until early November. In the afternoon, both bee-eater and raptor totals peaked at 15h00 and then declined for the remainder of the day. No bee-eaters or raptors were counted in migration after 18h00 at our watch site; indeed, bee-eater passage seemed exceptional after 17h30.

Discussion

Our study provides the first detailed information about the southbound migration of three bee-eater species through peninsular Thailand: Blue-tailed (6,909; 95.4% of all bee-eaters), as well as considerably fewer flocks and individuals (<1% each) of Blue-throated and Chestnut-headed. The survey provides the first evidence that *M. leschenaulti* is migratory in southern South-East Asia. Previously, Fuchs *et al.* (2007) demonstrated seasonal movement of *M. leschenaulti* in northern South-East Asia, although they did not directly observe it. Our study is consistent with the hypothesis of Wells (1999) that this species makes local (<100 km) dispersal movements within the Thai–Malay Peninsula, but the possibility that some *M. leschenaulti* were undertaking longer migration cannot be ruled out. By comparison, *M. philippinus* is returning from breeding potentially as far north as 27°N, while *M. viridis* is believed to breed as far north as 30°N (Duckworth *et al.* 1999, Carey *et al.* 2001, Evans 2001, Liu *et al.* 2008, Wu *et al.* 2009).

At Radar Hill, migrant raptors and bee-eaters pass close to the hill itself because these birds use deflection wind currents to conserve energy. The hill also serves as a landmark: a point in the distance to head towards. For bee-eaters, because the hill has vegetation, insects can be found here at the approximate level the birds are migrating.

Figure 2 suggests that peak bee-eater migration through peninsular Thailand is during the first half of October. This accords with Wells's (1999) suggestion of a peak migration time of mid-October for *M. philippinus* on the west coast of Malaysia, estimating a sustained rate of 150–200 birds/hour crossing from the mainland to Sumatra. Further north in Hong Kong, Carey *et al.* (2001) also showed the second week in October as the peak migration time for *M. philippinus*. During the peak migration time at Radar Hill over 4–10 October, we counted an average of 25.9 bee-eaters per hour of observation time, which excluded daylight hours of minimal passage, such as towards dusk and days of heavy rain. Future multi-year migration studies in the region might show that different

Merops populations (and different species) proceed south at varying rates each year, reflecting inter-annual differences in meteorological conditions. Currently, the timing and degree of *Merops* using an offshore migration route through the South China Sea from Taiwan to the Philippines are not well known.

Compared with a spring 2007–2008 study of northbound bee-eaters (DeCandido *et al*. 2010) at a site c.61 km to the south-west, these autumn data from Radar Hill show that (a) the average flock size was smaller; (b) on average considerably fewer birds were counted per hour; and (c) many fewer bee-eaters in migration were counted over the surveyed part of the season. The observed difference between spring and autumn migration counts suggests that the bulk of the southbound *Merops* migration may have passed elsewhere through the Isthmus of Kra, and that we therefore observed only a small part of the total southbound flight at our inland watch site. Alternatively or additionally, it might be that significant numbers passed outside the observation period before we began our study on 19 September. Casual observations in autumn 2009 (made by the authors and colleagues during this survey, but without impeding the effective coverage of Radar Hill) at a coastal site c.40 km to the east-south-east (Figure 1), adjacent to the Gulf of Thailand, known locally as Pencil Hill (Khao Dinsor), supported the first possibility. There we noted larger flocks and greater numbers of all three *Merops* species, and these were seen in migration at least into mid-November 2009 when our observations ended at that coastal site. In autumn 2010 at Pencil Hill, we confirmed that *Merops* migration is well underway at least by early September along the coast. Indeed, casual observations by one of us (CN) indicate that bee-eaters can be seen in migration over Chumphon by mid-August each year.

Future studies will confirm whether *M. leschenaulti* is a regular coastal (vs rare inland) migrant in Thailand, as well as provide information about other diurnal migrants commonly seen at Pencil Hill along the east coast including Ashy Minivet *Pericrocotus divaricatus*, Black Drongo *Dicrurus macrocercus*, Black-naped Oriole *Oriolus chinensis*, Dollarbird *Eurystomus orientalis* as well as Brown-backed Needletail *Hirundapus giganteus* and White-throated Needletail *H. caudacutus*. Each of these was an uncommon to rare migrant at Radar Hill during autumn 2009.

Finally, the pattern of bee-eater vs raptor migration observed at Radar Hill in autumn 2009 was very different from that in our spring 2007–2008 study, where we observed a significant relationship between wind direction/speed and *Merops* (as well as raptor) migration. During spring northbound migration in this area of Thailand, flocks of bee-eaters and raptors drifted inland as onshore easterly winds increased through the day. In the present southbound migration study, we found no significant relationship between numbers of migrants and wind direction or speed. For example, during the peak bee-eater migration in October, we counted the highest *Merops* totals between 11h00 and 15h00 (Figs. 3 and 4) as westerly winds prevailed, even though our site was 15 km from the coast.

In the future, we hope that long-term studies of bee-eaters and raptors be initiated at several sites from east to west across the Isthmus of Kra. We will then have a better understanding if most of the continental bee-eater migration takes place along the east coast of Thailand, and if this is true for the entire season. By mid-November, when strong north-east winds prevail on the Isthmus of Kra, does most of the southbound *Merops* and raptor migration drift to the west coast of Thailand? Where does the bulk of the *M. viridis* migration pass? Future studies will also determine the degree to which *M. leschenaulti* is migratory in southern Thailand. We strongly encourage multi-year, long-term migration studies to understand how numbers of migrants observed at particular watch sites vary from year to year in relation to meteorological conditions, breeding success and other factors. From a conservation point of view, further studies are needed to identify important stopover sites for foraging (if any), and critical staging areas (if any) throughout the region.

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